National Aeronautics and Space Administration
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NASA ADVISORY COUNCIL

May 18, 2006

Jet Propulsion Laboratory
Pasadena, CA

MEETING MINUTES

Christopher C. Blackerby
Executive Director

Harrison H. Schmitt
Chair

NASA ADVISORY COUNCIL (NAC)
Jet Propulsion Laboratory
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General Council Discussion

Senator Harrison H. Schmitt, Chair of the NASA Advisory Council (the Council) called the meeting to order at 8:00 a.m. and welcomed Council members and meeting attendees to the Council's third meeting. All of the background from the last meeting is available on the Council's website, including a letter to the Administrator with the Council's first set of recommendations. A detailed status of these recommendations is available from the Executive Director, Mr. Christopher Blackerby.

Senator Schmitt recognized two recently appointed members: Dr. Wanda Austin, Senior Vice President, National Systems Group, The Aerospace Corporation, and Dr. Bradley Jolliff, Research Associate Professor, Department of Earth and Planetary Sciences, Washington University (in absentia). He reminded everyone that the full Council meeting is open to the public and held in accordance with the Federal Advisory Committee Act (FACA).

At this meeting, the Council's five Committees will brief the Council on their recent fact-finding sessions and bring forward findings and recommendations for discussion. Since the last meeting, there have been two major NASA workshops: the Exploration Strategy Workshop in Washington, DC, with attendance from government, industry, academia, and international representatives; and a Science Planning Conference at the University of Maryland attended by about 60 members of four of the five Science Subcommittees. Several members of the Exploration Committee and the Council Chairman were in attendance at various times at the Exploration Strategy Workshop. The Subcommittees of the Science Committee, who gathered for the conference at the University of Maryland, discussed the NASA Science Plan and the general mix of Research and Analysis (R&A) and program activities in the Science Mission Directorate (SMD). The Planetary Protection Subcommittee was not present, as they had just met in March. The next conference of the Subcommittees is scheduled for July 6-7.

Senator Schmitt addressed an issue that became of concern at the Science Subcommittee Conference. The Science Subcommittee Conference ran into a problem with the budgetary "granularity" of some of the Subcommittee discussions. There were some potential conflicts of interest between some members and the topics presented for discussion and, on advice of NASA's Office of The General Council, about half of the Planetary Science Subcommittee participants had to recuse themselves from that discussion. Senator Schmitt indicated that he is working with NASA's General Council to ensure that clear guidance is available relative to the level of advice that can be sought from the Council and its Committees and Subcommittees. This issue is related to a broader issue of the best role for the Council and Committees. In attempting to gain desired advice, the Mission Directorates may ask the subcommittees to delve too deeply

into project and budget details and the subcommittees may not be able to advise the Administrator on such issues. Senator Schmitt asked the Mission Directorates and the Committees to keep this in mind and make sure that the members are looking at the longer term strategy.

Senator Schmitt next focused on a subject raised by the Administrator at the first meeting of the Council in November 2005: Why go to the Moon? This is a broad question, and some drafting discussions have taken place off-line. Senator Schmitt brought the Council up to date on the discussions and distributed a draft statement. The draft statement read:

> "Human exploration of space embodies basic instincts - the exercise of freedom, betterment of one's conditions, and curiosity about nature. These instincts have been manifested in desires for new homelands, trade, and knowledge. For Americans particularly, such instincts lie at the very core of our unique and special society of immigrants.
>
> Over the last 150,000 years or more, human exploration of Earth has yielded new homes, livelihoods, know how, and resources as well as improved standards of living and increased family security. In historical times, governments have directly and indirectly played a role in encouraging exploration efforts. Private groups and individuals often have taken additional initiatives to explore newly discovered or newly accessible lands and seas. Based on their specific historical experience, Americans can expect that the benefits sought and won in the past also will flow from their return to the Moon, future exploration of Mars, and the long reach beyond. To realize such benefits, however, Americans must continue as leaders of human activities in space.
>
> With a permanent resumption of the exploration of deep space, one thing is certain: our efforts will be comparable to those of our ancestors as they migrated out of Africa and into a global habitat. Further, a permanent human presence away from Earth provides another opportunity for the expansion of free institutions, with all their attendant rewards, as humans face new situations and new individual and societal challenges."

The Chairman commented that most members have indicated that they are comfortable with this statement, but he opened discussions on it, noting that some concern has been expressed about a lack of specificity. Additional statements have been discussed, and they should be drafted and considered by the Council.

Dr. Kennel commented about the role of governments in exploration. Although it has been a firm commitment of our western government, exploration has not been a universal trait of governments. Gen. Lyles said that, though it may be adequate if it is for Congress, he questioned whether the statement is compelling enough if it is meant to be a statement for the general public. Senator Schmitt indicated that it is a statement by the Council for the Administrator. It is a philosophical foundation, and not necessarily a

"rallying cry" for the public. Such additional statements could be developed that stand on this philosophical statement, which was not initially intended as something that would have the "wow" factor for the general population. He noted that Dr. Levy has volunteered to provide a more pragmatic statement. The question is: How do we articulate strongly enough to resonate with the public?

Dr. Robinson added that what will really appeal to the public is doing something; it is not clear what a "wow" statement would do without action. Ms. DiGennaro commented that every written work should be thought through as a marketing piece for NASA. This statement is somewhat wordy, with several different messages. She suggested using verbs rather than adverbial clauses and cutting down on the paragraphs. Dr. Huntress observed that the title, "Why go to the Moon?" is more confining than the content. Senator Schmitt said that the slide was mis-drafted and that the question should read "Why Go?"

Dr. Levy noted that his recent email expressed a couple of his concerns, including that the proposed statement is too broadly philosophical. A bigger concern is that, given the totality of what has happened to the program over the last 40 years, the statement needs to emphasize the importance of both human and robotic exploration. Mr. Montelongo suggested starting out with "Why return to space?" rather that the phrase "Why Go?" This ties to the historical background. The reasons for going that were stated in the 1950's and 1960's were very compelling, and are a way to connect with the current generation. Mr. Maddox questioned whether to consider that the survival of humankind may depend upon our going back to the Moon and beyond. Senator Schmitt indicated that there may be a way to say this in the statement as well. The Council will continue to work on the statement.

Senator Schmitt raised the topic of the inclusiveness of the Council advisory structure. He has discussed with the Administrator the possibility of forming a Space Operations Committee to serve an advisory function related to the International Space Station (ISS) and related operations. As one example of issues for such a committee, Congress has asked that the U.S. portion of the ISS be declared a "national laboratory." Senator Schmitt invited Council comments. This proposed Committee may incorporate the operations of the Ad Hoc Biomedical Committee. There were no objections to the Space Operations Committee initiative, and the Council agreed that the Chairman should move forward on its creation.

The Chairman reminded the Council that, currently, there is an Ad Hoc Committee on Biomedical Research. Also, Ms. DiGennaro has been working to form another Committee on "outreach," an ad hoc committee composed of volunteers from various other committees. The five science subcommittees report through the Science Committee. There are also a number of other advisory/analysis groups assisting NASA units. The Science Committee will continue to discuss whether these types of groups would be useful to the other science subcommittees. The Chairman is conducting an inventory all of the various advisory/analysis groups. A suggestion has been made to have the chairs of the various groups serve on the relevant Subcommittees, and NASA

and the Council are moving forward on this pattern. The Council does not want to interrupt the flow of advice from groups, but wants to ensure that the advice is more readily available and coordinated with other activities. Senator Schmitt welcomed any comments from Council members on this subject.

Dr. Covert stated that the inventory process embarked upon is very important, if for no other reason than to avoid unessential duplication of effort. It is important to get a number of points of view, but it is also important to have a single voice when appropriate. Senator Schmitt noted, in this regard, that the science and exploration parts of the Lunar Exploration Analysis Group have been combined. It is important that these "analysis groups" participate in the fall workshop being planned by the Science Committee.

Human Capital Committee Report and Discussion

Dr. Kulcinski reported on the Human Capital Committee deliberations. He noted that this Committee found it difficult to get quantitative metrics on activities in NASA under the Committee's purview. Since the last Council meeting, the group met in Minneapolis and worked on its proposed recommendations. At the fact-finding meeting on May 17 at JPL, there were presentations from Ms. Shana Dale, Ms. Angela Diaz, and Dr. Lynn Rothschild. Based on recent fact-finding meetings, the Human Capital Committee proposed five recommendations:

Recommendation #1: Reevaluate the current approach to NASA workforce recruitment in all disciplines. Target the “best and brightest” college graduates, practicing scientists, and engineers to address near-term (<2010) problems. Aggressively pursue the best and brightest K-16 students for NASA and NASA-related industries to have a major effect on the post 2010 workforce. There is a short-term problem in hiring because of the uncovered employees in NASA Centers. On the other hand, NASA demographics indicate that there will be a large fraction of employees eligible to retire in the near term. New skills will be required to achieve the Vision for Space Exploration, and there is a shortage of graduates in these fields. The U.S. could lose science and technology leadership and may not be able to compete in future missions.

Discussion:

Dr. Colladay commented that given NASA’s constraints, the Agency might benefit from the Council making a recommendation that NASA must have the flexibility to do the type of things that need to be done. Dr. Kulcinski agreed that on the surface, NASA’s hands are tied in the very near term. He noted that the Committee tried to think “outside the box,” and has some ideas on private/public cooperation. The problem is that if NASA doesn’t hire for a year or two, the job situation for graduating seniors and graduate students will impact students going into the fields that NASA will need. This will have serious effects on the pipeline of appropriately skilled future employees.

Senator Schmitt questioned how the Council could make a recommendation that would be helpful to the Administrator, since he will have to move through the Office of Management and Budget (OMB) and other groups to accomplish what needs to be done.

Dr. Colladay suggested that the weight of the Council behind Dr. Griffin might help him get that flexibility. Dr. Kulcinski added that the Committee considered how private and academic institutions could help in the short term, e.g., that graduates could be "hired" by them until the freeze is resolved. In response to a comment from Senator Schmitt, Dr. Kulcinski indicated that the recommendation could be modified to advise the Administrator to seek statutory authority to get around this dilemma. Gen. Lyles stated that there is a precedent in the Air Force, which had this problem and worked with Congress to obtain more flexibility. NASA should talk to the appropriate people there. Dr. Alonso noted that Council member Kay Coles James may be able to assist in addressing the issue.

Recommendation #2: Enhance NASA's efforts to attract highly qualified scientists and engineers for its space exploration programs. NASA should increase collaborations with other federal agencies and its industrial and academic partners to align with federal programs, such as the President's Competitiveness Initiative. This should help to address the necessary expansion of the pool of exceptional students in math, science, and engineering. NASA is in danger of losing many talented graduates to other fields of science and engineering. On the other hand, NASA will need talented scientists and engineers from other federal agencies to complete its exploration mission. The U.S. needs to continue its international leadership in innovation and avoid losing talent to other nations. Without this collaboration, NASA alone may not have the necessary resources nor the personnel to complete the future complex human exploration missions.

Dr. Covert added that without the proper personnel, the Agency would no longer be able to be informed buyers.

Recommendation #3: Streamline procedures for hiring foreign nationals. NASA's Office of Human Capital Management should reexamine the present federal policy for employment of foreign nationals. Roughly half of advanced degrees in science and engineering in the U.S. are awarded to foreign nationals. At the present time, out of around 18,000 NASA employees, there are only eight non-U.S. employees. The Space Act allows NASA to hire up to 150. It is important to revisit the present policy of underutilization of non-U.S. scientists and engineers working at NASA Centers. Unless NASA does this, the U.S. would not be taking advantage of at least half of the current pool of science and engineering graduates.

Discussion:
Dr. Schmitt noted that there were a sizeable number of foreign nationals in the Apollo program. Dr. Kulcinski observed that in the past, a great number of the foreign nationals would stay in the U.S. That is changing. China and India are becoming very attractive markets for new graduates, and, Dr. Covert noted, the U.S. is losing more and more talented students overseas, increasing the likelihood of international competitors.

Recommendation #4: Consolidate education resources and programs. NASA should consolidate all of the educational outreach programs under one Directorate. Approximately half of the education outreach budget is outside the Office of Education.

This type of structure causes redundancy, lack of efficiency, and lack of focus. If this consolidation is not done, there will be less efficient use of scarce resources within NASA.

Discussion:
At least half of the Education budget is earmarked by Congressional mandates. Dr. Kulcinski noted that this has been a relatively recent phenomenon. Some of it is straightforward, e.g., earmarks for museums. However, this is a very prominent and disturbing trend. Dr. Fisk agreed that the earmark trend is particularly egregious in the Office of Education. He asked the question: With respect to the recommendation, how is "education" defined? Does this include R&A, which has been an integral part of conducting research? Dr. Kulcinski indicated that the support of graduate students on research grants was not included in the Office of Education dollar numbers presented to his Committee yesterday, and he did not have those numbers. Dr. Fisk cautioned against creating an organization that is divorced from the missions, which is a pipeline for the future workforce.

Dr. Kulcinski showed the Agency-wide education investment for FY06, and how earmarks affected that budget. He noted that the Committee has struggled to understand the education structure. About half of the education budget ($300 million total) is under the Office of Education, and half goes to the missions. R&A is not included in these numbers. Dr. Fisk observed that there is a more fundamental issue: Is the workforce being adequately educated? NASA has a lot to do with education in terms of support, research projects, etc. What is NASA's and the nation's best interest in spending these resources to create the needed workforce? Dr. Kulcinski agreed, and indicated that examining these relationships is the direction in which the Committee is going.

Recommendation #5: Establish programs specifically targeted to the most academically talented K-16 math and science students. There is a need to maximize the potential of all students, including the highest achievers, who have the potential to tackle the most difficult problems facing NASA and the nation. This cohort is very often ignored in the belief that they need no encouragement to pursue NASA-related careers. As an example of the complexity of this issue, the decision to cut the Astrobiology Program in FY07 to 50% from its FY05 level will directly affect NASA's ability to attract top academic students and retain hundreds of top graduates in this area. Surprisingly, there are currently no NASA K-12 programs specifically targeting the most academically talented students (the upper 5% in math and science). This nation needs to maximize the potential of the top college graduates. If NASA doesn't do something in this area, the Agency will not have a sufficiently large pool of highly talented graduates to compete in the global science and technology area.

Discussion:
Dr. Alonso agreed with the recommendation and questioned whether the Committee discussed specifics on how to implement it. Dr. Kulcinski indicated that the Committee did discuss some specifics, but has not yet begun to assimilate all of the data and information coming in. It will most likely come back to this issue at future meetings.

The Committee is looking into public and private partnerships. In response to a question from Mr. Armstrong, Dr. Kulcinski stated that the Committee would like to "float all boats," but NASA must be somewhat parochial and try to attract people into its specific programs. To help do this, NASA should target the top students in a more specific way. Ms. DiGennaro noted that as proposals are being released for K-12 grants, it is important that the recommended realignment be put into practice immediately because the present guidelines leave out the top 5% group. Senator Schmitt suggested that this might be added to the background of the recommendation.

Dr. Covert asked about the dampening effect of outsourcing. If graduates think there are more opportunities in other places, they will go there. For example, about half of the aeronautics graduates go to work for large financial institutions as computer scientists. Dr. Kulcinski noted the drop in electrical engineering graduates over the past few years because of outsourcing to India. That is now beginning to come back. Dr. Austin expressed concern with emphasizing the "best and brightest" at the kindergarten level, and suggested that this be softened. Dr. Kulcinski agreed that this should be clarified. He indicated that "K-12" was being used by the Committee as a generic term. Dr. Colladay asked about the President's statement on competitiveness in his State of the Union speech, which has a lot of the same mission goals as the Committee is recommending. Dr. Kulcinski indicated that the Committee did discuss this, and the Competitiveness Initiative was mentioned in Recommendation #2. The Committee did not get a sense that NASA was closely "plugged into" this Initiative, and the recommendation could be a little stronger in that regard.

Dr. Kennel noted that the aerospace industry has the same interest in the workforce that NASA does. NASA and aerospace industries could organize to form a component under the President's Competitiveness Initiative. Dr. Levy added that there is a question whether NASA is presenting itself as an attractive employer, given what is happening in the science budget. NASA must be seen as a robust and attractive place to work in order to attract the top talent and it is difficult to persuade students to enter the fields of science and engineering when R&A is being cut. Dr. Kulcinski noted that there is a near-term problem as well as a long-term problem. A lot of damage can be done in the near term that can seriously affect the longer term. Astrobiology is a good example of that. Senator Schmitt asked whether anything can be done in the short term given the constraints imposed upon the budget, largely from the outside? He continued, saying that it is not clear that much can be done in the short term, but the Council should consider how the damage in the longer term be minimized. Mr. Maddox commented that the Committee wants to examine what is currently being done in recruitment and would like to meet with NASA Headquarters to discuss the short term issue.

Dr. Kulcinski indicated that he would take the Council comments into consideration. Dr. Fisk noted that the workforce issue is broader than just the NASA and Center civil service workforce, and the Committee should make it clear that it is addressing more than that population. The Council approved moving forward with the recommendations, incorporating the comments and suggestions of the Council members. Senator Schmitt cautioned getting too far into specificity at this time. As the Committee and the Council

see the reaction to the recommendations, the Committee may then go to a more specific level if necessary.

Ms. DiGennaro noted that the Ad Hoc Outreach Committee, possibly to be called the "Network Committee" for the foreseeable future, was tasked to come up with a list of entities that could be considered by NASA for partnerships and other relationships to assist the Agency in strengthening its mission, with emphasis on long-term needs. The Ad Hoc Committee will develop a plan for the Human Capital Committee to present at the next meeting. Ms. DiGennaro indicated that she has spoken to several of the Ad Hoc Committee members to look at where to go with these partnerships and relationships.

Ms. DiGennaro opined there is concern with the production and preparation of top-notch engineers in this country. There was a recent study that says that China is producing eight times the number of engineers as the U.S. Regardless of the accuracy of the cited numbers, Ms. DiGennaro said that the U.S. needs to have more engineers. There has been no national strategy to produce more engineers, and it is not even clear how many engineers the U.S. does produce. Some universities have the computer science departments in engineering, but some would say that computer scientists are not engineers. The first step is to see how "engineers" are defined, then examine how many are being graduated, and then look at how to go forward with a project in that area. Ms. DiGennaro invited the Council to provide suggestions and input. In response to a question from Senator Schmitt, she indicated that the National Academy was not able to provide the number of engineers being educated. Dr. Colladay added that this is a work in progress by the Academy. It has had trouble getting data that it could sort and understand, and there are traps in interpretations. Care must be taken in collecting and sorting the data. Capt. Hauck mentioned an initiative in Massachusetts where the legislature passed a law requiring that all students in the middle school grades be given a basic grounding in engineering. He asked if there is a role that NASA could play in facilitating and encouraging such requirements at the state levels?

Ms. DiGennaro added that for the partnerships and collaborations relative to K-12, a NASA "summit" is planned, but it is not clear what is being done with this. Senator Schmitt indicated that the Council would find out more information about this activity.

Audit and Finance Committee Report and Discussion

On behalf of the Chair, Mr. Robert Hanisee, Mr. Stanislawski provided a report on the Committee's findings on NASA's audit and finance issues. Agency accounting problems are rooted in Centers that historically operated with a high degree of autonomy—10 different accounting systems with 120 different subsystems that have now been consolidated into a new Integrated Enterprise Management program (IEMP) and a common accounting module. A significant part of the current problems are rooted in unreliable historical data. The Committee has been developing its fact-finding and has been meeting with government managers and auditors. It had two such meetings earlier this month.

Yesterday, the Committee met with a team from the Jet Propulsion Laboratory (JPL), including the person that supervises the contract under which JPL operates. JPL essentially functions as a Government-Owned Contractor Operated (GOCO) organization. Caltech has a contract with NASA and everything runs under that contract. Caltech uses an Oracle system for accounting and this system does not easily "talk to" the NASA system, SAP, which is a competitor product. The Committee also met with the Deputy Administrator, Ms. Shana Dale, and discussed its findings and recommendations from the February meeting and how it could work with her office to develop additional recommendations. The Committee has confirmed its initial recommendations and discussed additional observations.

The Council recommendations in this area that grew from the February meeting have received a favorable response from NASA and are in the process of being implemented. The Committee has a good working relationship with the Office of the Chief Financial Officer (OCFO). It is continuing to collect information and facilitate the evolution of the accounting problem into a clean bill of accounting health.

Mr. Stanislawksi reviewed the Committee observations. There were several years of unqualified (acceptable) audits, followed by years where problems started to emerge. However, the history of unqualified audits is not necessarily a rosy one. There were identified problems with unreliable data, and the recent trends reflect historical problems that were not spotted earlier. There have been various reports and Corrective Action Plans (CAPs).

The General Accounting Office (GAO) had issued 45 recommendations for accounting improvement, only 3 of which specifically belong to the OCFO. All of them reflect institutional problems. Thirty-two of the recommendations are considered closed by NASA. The expectation is that most if not all of them should soon be closed. The basic "ownership" of this activity is at the Deputy Administrator level, as the Chief Operating Officer. Ms. Dale has instituted some processes that have brought the stakeholders together. She is the leader of this work and has regular meetings with all of the players. NASA is going back to GAO to validate and confirm the closing of the recommendations in order to get NASA off GAO's "high risk" list.

There are four areas of substantive problems: (1) financial systems, analyses, and oversight; (2) funds balance with treasury; (3) asset management/property, plant, and equipment; and (4) environmental liabilities. The Committee is following progress in all of these areas. Implementation of the public sector SAP system is a lengthy process, and a major upgrade effort is in progress. Substantial tailoring was required in this public sector SAP offering. In the end, it will yield useful and reliable information. Mr. Stanislawski indicated that the Committee believes that things are moving in the right direction, the problems are understood, and solutions are being implemented. In response to a question from Mr. Maddox, Mr. McPherson indicated that the previous reports were presented as "full" audits, not merely reviews.

The second area, funds balance with treasury, appears to be more easily resolvable. Mr. Montelongo explained what is meant by funds balance with treasury—essentially a "balancing of the checkbook." NASA has done all of the homework to reduce the variance to several million dollars, which is significant progress. The problems were due to breakdowns in processes and insufficient accounting knowledge and training. "Intergovernmental transactions" is an area that haunts a lot of federal agencies and throws off the balance with the "bank" (treasury). NASA and the CFO should be commended for the work that has been done to bring the Agency into closer balance with treasury.

The third area was also discussed at the last meeting. The issue has to do with how NASA assets are determined and depreciated. There is a problem with what the assets are, where they are, and what they are worth. There is still some controversy about all of this within the Agency, and this issue will take some time to work off. Some of the solutions may require new or modified government financial audit standards, which is a cumbersome and lengthy process. The existing government standards are not drafted to deal with NASA's issues, e.g., depreciation of assets in space. General Accepted Accounting Principles (GAAP) are used when there are no specific government regulations. Under government cost accounting standards and regulatory systems, there are many differences with GAAP, and for the government, GAAP is not the top priority standard. Hence, the government does not always accept that GAAP offers the best solution to a problem. Mr. McPherson added that the property and plant equipment reflects "deferred work."

The fourth area is complicated and has to do with NASA's exposure to liabilities and how to take them into account. This area is work in process, but is not likely to be resolved immediately. The government doesn't have the same kind of approach as the private sector. The government makes commitments subject to appropriations. The issue here is that there is not an established set of procedures for measurement. Solutions for estimating the liabilities are being developed.

The Committee has made it clear that NASA should stay the course. The CAPs are sound, and progress is being made. There are priorities in each of the areas. The upgrade of SAP, due in October, is very important. It will determine the integrity of the entire accounting process. It appears that the funds balance with the treasury will be one of the first areas to be resolved. There is a significant issue with respect to procurement and the procurement process. Mr. McPherson added that the issue is integrating the procurement function with the general accounting function. Deputy Administrator Dale is focusing attention on getting these parties to work together. From what it has heard to date, things are on the right track and the Committee is pleased. One area of concern is the availability of adequate resources. NASA does not appear to have sufficient resources to properly address these problems, although efforts are being made to hire more people. Resolution of all of the problems is a people-intensive process, and NASA is currently understaffed. Filling the vacancies should be a high priority for the Agency.

Mr. Montelongo commented that once NASA can demonstrate that it is making substantial progress on integrity of data and move the Agency off the high risk list, it can then focus on areas that are harder to resolve, e.g., the environmental area. Mr. McPherson added that effective leaders are essential in order to produce results in a reasonable period of time. In response to a question from Senator Schmitt, Mr. Stanislawski indicated that the Committee did not see any apparent "red flags" at this point. However, Mr. McPherson added that unless an agency has a good grip on the work over several consecutive years, it can easily lose a clean audit report.

Senator Schmitt noted that there is a longer-term, larger issue on how major programs are managed. Mr. Stanislawski indicated that the Committee had not yet looked at this aspect, but would add it to its list. Dr. Fisk encouraged the Committee to get into the programs where the financial data is often not adequate and useful to program and project managers. Mr. McPherson added that the Agency has under-invested in training on financial management systems. Gen. Abrahamson commented that in the past, there was not enough data to evaluate and come to what would be a fair price on major program elements, e.g., the Shuttle. With the Exploration Vision, there are projects that may have merit, and the question is: Is there a basis to put together business-type arrangements? There have been some good examples, e.g., JPL's arrangements with the Keck Telescope. Given the basic accounting questions, has the Committee had a chance to examine some of the initiatives to see if NASA is positioning itself for the future in order to credibly propose joint commercial/government efforts? This is a complex area and warrants some interest. Mr. Stanislawski indicated that the Committee has not yet looked into specific programmatic aspects, but will discuss how it can expand its activities into this area.

Mr. Montelongo noted that businesses are moving away from being transaction oriented, but government agencies are about ten years behind the private sector. As the Committee begins to see more progress with the transaction aspect, it can look into how to promote the Agency's ability to bring in revenue. Success will look like a shift from the bulk of the time spent on compiling data, and more being done on analysis and interaction with the Agency's leadership. Senator Schmitt added that one of the longer-term results should be that major cost growths and overruns do not surprise the Administrator.

Aeronautics Committee Report and Discussion

Mr. Armstrong reported on the Committee's findings. Proposals in response to NASA's Aeronautics Research Mission Directorate Request for Information have been submitted to NASA Headquarters and are being reviewed by Panels. Center-based reviews have been completed. Ten proposals were received; eight were provisionally accepted. Two had inadequate technical plan clarity. The selections will lead to a NASA Research Announcement (NRA) around late May with an estimated response date of late July. The content will cover a wide range, including hypersonic flight, air traffic control, aircraft durability and aging, etc. Senator Schmitt asked if some of these issues were already coordinated with the Federal Aviation Administration (FAA), and Mr. Armstrong said that to some extent they are.

As part of the Committee's continuing efforts to look at the needs of aeronautical research, the chief scientist of the Air Force, Dr. Mark Lewis, was invited to meet with the Committee. Gen. Lyles summarized that discussion. One of the major action items was to encourage partnership between NASA and other agencies. At the last Council meeting, there was a representative from the joint planning office of the FAA, who talked about the next generation air traffic control system. All of NASA's activities appear to be in sync with that office. Dr. Lewis provided an Air Force perspective. He talked about the growing support and cooperation between NASA and the Air Force, and the participation of the Air Force in Dr. Porter's reviews. Dr. Lewis noted that Dr. Griffin has been aggressive in reaching out to all of the stakeholders in the aeronautics area, including the Air Force, and the Air Force scientific advisory board is very impressed with what he is doing. The Committee was encouraged to find out about an Air Force/NASA Memorandum of Understanding (MOU) currently in work. Dr. Porter recognizes that it is not adequate to just talk to each other; it is important to codify the arrangements. The Committee would like to take a look at the document to understand the nature of the cooperation of the agencies in this area. Gen. Lyles indicated that he would like to meet with the current Vice Chief to talk about how the Air Force will disseminate and act on the document.

The second area of discussion consisted of comments from Dr. Lewis on the proposals. He was encouraged that Dr. Porter is including other first-level stakeholders in the review process. There is no "entitlement;' all proposers must meet the rigors of the process. There are strong ties with universities in the aeronautics sectors. However, at this point, the universities are not participating in the review. This is the first step in a four-step process for aeronautical research. The Committee will continue to examine the review process. Dr. Lewis was very impressed with the responsiveness of the review teams and noted that the entire process appears to be going in the right direction.

Dr. Covert added that one of the difficulties is using the term "fundamental" to define the research program. This is slightly at odds with how the world defines fundamental. Dr. Porter is looking at practical applications. It is vitally important to get the industry on board to help define the holes in technology. Gen. Lyles added that the whole purpose of good partnerships is to ensure no overlap and that NASA can leverage the resources in the aeronautical regime. It is very important that everyone is speaking the same language. We need to understand what the terms mean so that there are no gaps. There needs to be clarification among the stakeholders and the Committee will work this issue.

Mr. Armstrong noted that the Committee has no specific recommendations to make at this time, but one is in formulation phase. Dr. Covert commented that to be an informed buyer, NASA needs to hire engineers, let them work their way up, provide training, etc. The same thing goes for auditing systems. Bringing in young people and training them well applies to all parts of the Agency. Senator Schmitt noted that the aircraft industry may have training programs designed to "mature" young engineers in aeronautics, and that NASA might tap into such programs. Gen. Lyles commented that a couple of years ago, the Air Force created a Center of Excellence for Engineering. This is now a joint Air Force/Navy Center at Wright Patterson. NASA should tap into this Center, not only

to learn but to teach. Dr. Covert added that in his view, one of the things that a system engineer needs to learn is to understand all of the technical issues that are involved in the "system." The training effort should be limited to people with 10-12 years of practical experience so that they appreciate the depth of the subject. Gen. Lyles indicated that the training should start with people who already have experience. Senator Schmitt asked the Committee to consider whether there should be a specific recommendation in this area.

Dr. Kulcinski indicated that the need for well-trained systems engineers has been recognized in academia, and more emphasis is being placed in this area. Typically, systems engineering is interpreted in the area of manufacturing. Senator Schmitt asked that the Committee take an action to find out whether NASA is aware of and tied into the DOD activities. Gen. Lyles noted that terminology is important, saying that what they are talking about is actually a "system of systems"—it is broader than just general systems engineering.

Gen. Abrahamson observed that in learning about advanced materials and advanced materials problems, he saw a panoply of new tools. NASA has been a leader in expanding what is being used. Nearly every graduate student has a computational fluid dynamics program on his laptop. The same trend is happening in structural dynamics programs. There are people who are using these advanced tools and there is a great deal of attention on whether they are properly vetted. The tools are being joined so that they are interactive. Gen. Abrahamson posed the question: Is there an index or some way of surveying these advanced tools and their validation? If this doesn't exist, it would be a handy reference. It could act as an "engine" to thrust the tool development forward. Dr. Covert stated that to the best of his knowledge, no such catalog exists, but it is an excellent suggestion. One of the problems is verification and validation. This is not as well-developed as people think it is. A number of attempts have been made to synthesize programs. Generally, they are less than successful because of the complexities involved. All of these programs are generally excellent analysis tools, but they are not synthesis tools. Systems engineering is a synthesis process; it requires people and judgment. Gen. Abrahamson noted that the catalog would lead to a process that would provide more confidence in the tools that are out there or are being developed. The key is to understand the weakness and limitations of the existing programs in order to improve them.

Dr. Alonso commented that the issue of verification and validation is the next frontier of computational science. The major constituency is in the Department of Energy. This is fundamental research and NASA should be taking a lead in the fluid dynamics area. Dr. Alonso defined validation as solving the right problem, and verification as solving the problem right. It is not just about getting the right solution, but is also about getting the uncertainty margins in the right solution. Linear structures have shown that there are techniques to providing solutions, but fluid dynamics research is not close to putting these techniques to use. Mr. Armstrong said that the Aeronautics Committee will look into this in more detail and bring back to the Council.

Gen. Lyles noted that the Committee decided to look in detail at NASA's plans for the wind tunnels and other facilities as tools. Gen. Abrahamson suggested tying the discussion into two other activities: the dynamics of materials and nano-materials; and the potential jump in capability in failure modes. NASA has had a leadership role in this area, and should continue at some level, even within the funding limits. The question is: In our uses of computational tools, can we predict or analyze to the level of assured reliability? Dr. Covert agreed that these tools need to be more widespread than they are and the Committee will look into their use. Dr. Alonso noted that at a workshop at Stanford last year, people were worried about these issues, but they noted that such computational measurement tools are emerging.

Gen. Lyles asked how we will we know five years from now if we are successful in the aeronautics regime? It gets to the issue of stewardship. If NASA has the stewardship of aeronautics research, what issues must be addressed? The Committee is still wrestling with this topic.

Senator Schmitt encouraged all of the Committees to think in terms of what qualitative and quantitative methods are there to evaluate progress in their areas of responsibility?

In response to a question from Senator Schmitt about embedded diagnostics, Dr. Covert indicated that it may not live up to all of the expectations that people have, but it should be worked on to improve its applicability in a broader sense. There is still a long way to go before they can be applied in a general situation. Dr. Alonso added that one of the eight accepted proposals is in this area.

Gen. Lyles stated that the nation needs a national aeronautics policy, and this activity is underway with the intent to have something signed by the end of the year. It is being led by the Office of Science and Technology Policy (OSTP). The Committee would like to look at a draft of this policy and NASA is working to see if it can arrange this.

Mr. Armstrong noted that the Committee is mindful of the civil world and its needs. A decadal study of that area has recently been completed but is not yet released. Dr. Colladay reported on this item. The report is working its way through the review process, and is independent of what NASA has been doing to restructure the aeronautics program. It is an assessment of the top challenges in aeronautics. The report should be out at the end of the May. As soon as it is released, the Committee would like to schedule a meeting to get a briefing from the Office of Aeronautics on the report and how NASA will respond to it.

Mr. Armstrong noted that the Committee is also focusing on how to make its analysis and recommendations more useful to the Administrator. Dr. Alonso commented that the Committee is considering how to establish accurate metrics and procedures to take into account the important criteria. It is concerned about the needed overlap between aeronautics and space applications. Senator Schmitt asked that the Committee consider adding thermal protection systems to its list of topics.

Exploration Committee Report & Discussion

Gen. Abrahamson introduced the Committee's report, and members of the Committee discussed the proposed recommendations. He noted that the Committee is seeing a NASA in transition that is facing a very challenging future. It is important to tell NASA when it is on the right track and doing something well. The Committee is hearing and seeing wonderful things. One of the gems was the Exploration Science Workshop that occurred at the end of April. One impressive thing about the workshop was that there were people who were defining an initiative beyond NASA, industry, aerospace, and the U.S. They have begun to lay out an initiative for mankind.

Before discussing the first finding, Capt. Hauck indicated that he was also impressed with the Exploration Science Workshop. One issue that was raised by Dr. Griffin was the need to develop a "dexterous hand," i.e., a space suit that is much less encumbering. The "next generation" suit will be worn in the Crew Exploration Vehicle (CEV) as it goes to and from the Space Station. It is clear that there must be a progression of suit development, and those development lines must be started in a timeframe that will allow them to be useable for the first lunar sortie mission. If the proposed action is not taken in a timely manner, it is possible that this critical piece of hardware will not be available when needed and there could be a possible delay in the execution of the program. The Committee expects to pursue this topic at the next meeting in Houston. There is a Centennial prize competition currently underway for designing a better glove. (Teams are tasked to design and manufacture the best performing glove within set parameters. A $250,000 total purse will be awarded at a competition scheduled for April 2007, when competing teams test their glove designs against each other. More information at http://exploration.nasa.gov/centennialchallenge/cc_challenges.html#glove.) Senator Schmitt commented that the space suit is actually another "spacecraft" and requires as much attention as the modules. In addition, longevity and maintainability must be introduced into this item. There is a great heritage of information on suits used on the Moon, as well as a heritage of information on what has been used since then. However, a "clean sheet" approach may be required.

Dr. Longnecker noted that the exploration missions would have far more Extravehicular Activity (EVA). He reported that the Ad Hoc Biomedical Subcommittee, which has had four meetings plus regular electronic meetings, has developed a series of questions to help address some of the biomedical issues associated with exploration. During that process, Dr. Neal Pellis, a noted immunologist and scientist who now is at NASA, worked to coordinate a response to these questions. The biomedical sciences are being considered by the Council through the Exploration Committee. Dr. Kennel commented that it would be pertinent for the Exploration Committee and the Science Committee to work together on long-range and institutional issues.

The short title for the proposed recommendation from the Ad Hoc Biomedical Committee is: "A plan for biomedical research to support the President's Vision for Space Exploration." In order to inform and support the engineering and technical development associated with the initiative, and to foster crew safety and mission success for long-

duration exploration missions, it is recommended that NASA do the following: (1) foster relationships with governmental agencies, industries, universities, and individual investigators that offer opportunities to bolster the content of the NASA research portfolio, which currently contains gaps, especially in the basic research that will be required to support the Exploration Vision; (2) construct a plan for mining the existing biomedical data on humans in space, including enhancing access to those data for the broader biomedical research community; and (3) complete an integrated research plan that embodies an ordered approach to conducting relevant experiments, garnering partners in government, academia, and industry, and soliciting research to answer critical questions aligned temporally and conceptually with NASA's Constellation Program. Dr. Longnecker noted that in the longitudinal study of astronaut health, there is data that has been collected and not analyzed. By opening this up to the larger biomedical community, it would link the data with research done by NASA. Senator Schmitt commented that the longitudinal physical exam for astronauts does not touch on several important issues. Only recently, for example, has NASA starting to look at the issue of bone density.

Life sciences research at NASA has been condensed into the Human Research Program, with all projects directly mapping to human exploration of space. Biomedical research is concentrated on applied research in five principal areas: human health countermeasures; exploration medical capability; space radiation; space human factors and habitability; and behavioral health and performance. Applied research is identified as those areas with Countermeasure Readiness Levels or Technology Readiness Levels of four or greater, but two thirds of the deliverables in the Bioastronautics Roadmap are below this threshold. Only 3% are at levels 6 or 7. Senator Schmitt indicated that some techniques are at 8 or 9 and should be included. Dr. Longnecker agreed, but observed that these have not been included in the Roadmap. Dr. Pellis stated that Senator Schmitt's observation was correct. There are some items in the higher ranges of CRL 8 (flight validation) and 9 (Implementation).

Senator Schmitt asked that an action be taken to get an update on things ready for flight validation or things that have already been implemented. Dr. Longnecker agreed to bring this forward at the next meeting.

Dr. Longnecker noted that many projects involve areas of research that are of great interest to the wider biomedical research community outside of NASA, and that have application to public health for all Americans. For example, NASA-funded research has identified new methods for diagnosing cataracts. Microgravity is a wonderful laboratory for accelerating the study of issues associated with aging. NASA offers unique resources in facilities, technology, and expertise that complement the needs of the biomedical research community that have not participated in NASA research. There is tremendous potential for nanotechnology, and NASA has one of the leading nanotechnology laboratories in the world. Dr. Kennel commented that at the University of California San Diego, there is a group pursuing use of nanotechnology in the body.

Ms. DiGennaro asked about joint funding between NASA and the National Institutes of Health (NIH) and Dr. Longnecker responded that some limited cooperation does exist

and there are opportunities to work together more in the future. Dr. Longnecker reported that at the February meeting, the Committee met with the Director of the National Cancer Institute. There have been jointly funded grants in the biomedical area. However, in the broad sense, it is a relatively small amount of the portfolio of either agency. The National Cancer Institute is jointly sponsored by both NASA and the NIH.

Closing the "gaps" between currently funded research and the research needed to inform and support the Exploration Vision will be critical for the short-term development of the Exploration Architecture, for the design of the lunar mission, and for the longer-term Mars missions. If no action is taken on the proposed recommendation, development of standards and requirements for the new CEV would be delayed or inadequately informed. In addition, the key biomedical research that is required to support the Exploration Vision would be delayed or these missions will proceed with added risk to mission success and crew health and safety.

NASA is focusing on applied human research. In order to move the Vision forward, there must be a parallel process for the basic research that has to be done to form the foundation for clinical and applied research. Senator Schmitt added that this research can also offer information relative to better understanding of human physiology in general. Dr. Katz has been working on a parallel process at the NIH, looking from the larger biomedical community side. The Committee expects to hear from that group at the July meeting.

In response to questions from Dr. Robinson about the availability of Soviet data and the issue of data accessibility, Dr. Longnecker indicated that accessibility has several components. One is privacy—a lot of data has not been available due to the very high hurdles one has to take to gain access to it. The second component is a lot of data that hasn't really been examined due to lack of resources. Senator Schmitt noted that there are software archive programs in use in the health care industry that could be useful for entry and mining of the NASA data. Dr. Pellis agreed that there are several different formats that could be used. In response to a comment from Mr. Armstrong, Dr. Longnecker indicated that health care in the Exploration Vision involves a number of issues, e.g., what conditions will or will not be treated, how they will be treated, etc. Mr. Armstrong said that questions about health care on long duration flight (e.g. Who will deliver it? what will it be?) need to be addressed soon.

Science Committee Report and Discussion

Dr. Kennel reported on the Science Committee findings and recommendations. The two most important things that have happened since the last meeting have been the emergence of two sources of input: (1) the National Research Council (NRC)/Space Studies Board (SSB) report on the FY07 science budget (released in May); and (2) the formation and establishment of four more of the five Science Subcommittees. For the better part of a year, the former subcommittee connections with the Science Committee were dormant. Two pathways have now been re-established that have served NASA very well since the Space Act was passed, and the close relationship with the subcommittees should continue to be used frequently.

On May 3-4, there was a Science Planning Conference at the University of Maryland. Four of the five Science Subcommittees met separately and together for the first time. Just before this conference, the NASA science budget had been released. There was a condition in the budget that the science budget would grow at less than the inflation rate, in contrast to a much higher growth for a number of previous years. The two concerns were: (1) that NASA needed to work closely with the Science Committee and its Subcommittees to decide the optimum way to react to the budgets adjustments; (2) there might have been a better way to balance out the cuts. The group did not have any way of examining these issues in detail. The purpose of the conference was an opportunity to look at options for rebalancing the program.

Before proceeding with the report on the Science Planning Conference, Dr. Fisk discussed the NRC report and indicated that it could be made available as a pdf file to the Council members. In the 2005 appropriations bill for NASA, there was language that asked the SSB to assess the impact of the Vision on science. The SSB has been trying to answer this question. An early report was intended to set the roadmap activity in motion and provide guiding principles for it. The roadmapping activity was curtailed about a year ago. Last fall, there was a review of the Space Station roadmap. This latest report is the final chapter—the impact of the Exploration Vision on science today, as embodied in the FY07 budget runout. This was a report for Congress, not NASA per se, and the NRC was free to tell Congress that more money was needed.

The first finding was that NASA was being asked to accomplish too much with too little. The report asked both the executive and legislative branches to come to grips with this mismatch. It then focused on the impact on science. The science program in NASA comes in two pieces: (1) space and Earth science in the Science Mission Directorate; and (2) the biomedical and life sciences in the Exploration Directorate. The budget cuts had fallen disproportionately large on the small missions and the R&A budget, and had some severe impacts on the robustness of the science program. This needed to be corrected, and a relatively small amount of dollars could do that. The NRC called for a fix. There are R&A funds spread throughout the Science Mission Directorate, and there were elements of R&A that were not hurt. What was hurt most were the technology parts, an integral part of the pipeline. The Astrobiology Program was singled out as a particularly large cut. It has been a flagship program for NASA, and has been a major factor in luring very smart people into the agency. A disruption of that pipeline would be very detrimental to the Agency. Doing the same comparison for life and microgravity sciences, about 70% of that program has disappeared. Physical sciences and materials research has gone away, and only a much smaller portion of life sciences remains. A major concern is the human capital issue. The best and brightest will go elsewhere rather than apply their skills and interests to space. In many of these areas, a generation has been lost. This is the most graphic demonstration of the inadequacy of the bottom line for NASA.

The SSB report also dealt with the cost increases projected for the flight science programs, particularly the flagship programs. There are major factors of difference in

what they are costing versus what was estimated when the programs were initially proposed. Those cost increases have destroyed or disrupted the orderly planning process that was followed for years. The NRC recommended that NASA conduct an independent and systematic cost-to-complete for each program and seek options for reducing costs while maintaining the mission capability. A final recommendation dealt with community involvement in the planning of missions and programs, i.e., reinstate the advisory structure that has served NASA so well over the years.

Dr. Kennel continued with the report on the Science Planning Conference. The participants were asked for input regarding where adjustments should be made. The Subcommittees did not reach conclusions about offsets. Various reasons were offered, including that it was the first meeting of the new Subcommittees, and discussion was inhibited by interpretation of conflict-of-interest rules, especially in the Planetary Science Subcommittee. Senator Schmitt noted that there are a number of issues regarding overly restrictive interpretation of the federal conflict-of-interest statutes. The NASA Mission Directorates that request analysis and input from Subcommittees need to be sensitive to the specificity of the requests. This issue is in work, and Senator Schmitt indicated that he is working with NASA's General Counsel to find ways that the issue can be resolved.

Dr. Kennel stated that a more direct discussion is essential. The interest of the Administrator in this area is very clear. This Conference was a beginning, not an end. In any case, it is NASA's responsibility to make decisions; the Subcommittees' job is to provide recommendations on how to make these decisions in the future. Although the Subcommittees did not reach conclusions about offsets, they did arrive at a set of common views on key issues. The Subcommittees endorsed the SSB report. They were concerned about the inadequate R&A funding, especially in Astrobiology. They were also concerned about near-term investment in technology, the balance among large and small missions, stability in programs, and constraining mission costs.

The Science Committee developed recommendations on R&A/Program Mix in the FY 07 budget. Given the common views of the SSB and the Subcommittees, the Committee believes that "no action" is not an option, even given the lack of consensus on offsets. There are key milestones ahead at which the guidance provided by the Subcommittees (and endorsed by the Science Committee) can be implemented. There is no specific recommendation for change in FY06, but NASA should avail itself of opportunities to make adjustments in accord with the Subcommittees' common recommendations. NASA should revisit the FY07 budget after it is passed on the Hill. In formulating the FY08 budget, NASA should use the "common recommendations" from the Science Subcommittees. The issues should be addressed in the forthcoming Science Plan.

Senator Schmitt suggested that the language of the recommendation not reflect a Council endorsement of the SSB report to Congress. Dr. Fisk clarified that the SSB report is funded by NASA and goes to NASA in the same sense that it goes to Congress. It is not exclusively for Congress, and the Council should be free to comment on the report. With this clarification, Senator Schmitt agreed that the Council likely could proceed on the recommendation.

Dr. Kennel commented on the Science Plan. It is required as both a Science Mission Directorate (SMD) strategic plan and as a response to a request from Congress. The draft will be reviewed in July by the Subcommittees and the Committee and again at fall meetings. The Committee considers the outline of the basic form of the plan to be sound. The draft should be developed using the following guidelines: (1) in each area, define key scientific questions; (2) define reasonable progress in each area by 2016; (3) while the means will differ from question to question, each area should describe the roles of major project elements (R&A, technology, large and small missions, etc.); (4) use OMB budget guidelines as the financial envelope to define missions and specific programs and science and technology investments that need to be made now to enable a robust set of program/mission options in 2011; and (5) use this planning exercise to inform the FY08 budget formulation. The Science Committee proposed that the Council recommend this approach to NASA. Senator Schmitt stated that this was an outstanding approach. In addition, the SMD should provide the Science Committee with the appropriate entry points into the process. At the July meeting, there may be some specific suggestions beyond these recommendations.

The Science Committee looked at the rising cost of scientific programs, specifically the James Webb Space Telescope (JWST). This project was under-costed and under-bid. A combination of phasing and budget reductions led to major modifications and cancellations among other Astrophysics missions. JWST and the Hubble Space Telescope (HST) threaten the stability of other Astrophysics projects as they both will reach their peak costs in 2008-09. Other science is threatened as well. Extraordinary financial vigilance is required not only to maintain projects but also to maintain the intellectual integrity and stability of the entire Astrophysics program. This requires a good financial tool for decision support. SMD should undertake a study of cost drivers of large missions, especially with regard to process and procedures, to determine how much cost they contribute. SMD should assess the stability of the program in terms of an optimal portfolio of flagship, medium, and small missions. The Directorate should define different levels of processes and procedures for small, medium, and large mission classes. It should emphasize flexibility in small missions and accept some increase in perceived risk. NASA's Office of Program Analysis and Evaluation (PA&E) should be part of this process.

Senator Schmitt added that there is an under-costing problem across the board, and this must be tackled. Dr. Fisk commented that the last recommendation should get some particular emphasis. There is an important issue about how small, medium, and large missions are managed. In some cases, the small missions have grown because they were priced under one management structure, and as the project moved forward, a different management structure came into place. There must be a different process for small missions. NASA can get more for its money if it could find a way to have the appropriate level of oversight depending on the size of the mission. Dr. Covert also noted that requirements creep is hard to resist; it requires discipline at the start and continued vigilance. He suggested including something about this aspect in the recommendation.

In response to a question from Mr. Maddox, Senator Schmitt indicated that both the Exploration and Science Committees may want to consider these financial management issues. Risk management is a component of financial management, and the Audit and Finance Committee may want to look at this issue as well. Dr. Covert added that an ambitious exploration program of this kind cannot be conducted without recognizing there will be risk and some losses. Senator Schmitt suggested one way to mitigate the problems of requirements creep is to double the initial engineering cost estimate, and attempt to pay for design engineering in NASA that parallels that in the contractors.

The Council agreed to accept the Science Committee recommendations.

With respect to Astrobiology, the Science Committee recommended that NASA's Astrobiology Program be treated in the same way as any other R&A program, and should be included in future planning. These scientific investigations support NASA's strategic goals. This program is particularly attractive to the broader science community and the general public. The Science Committee will also look at the human capital aspects of the R&A program. The Committee met briefly with the Exploration Committee in a fact-finding session on May 17 and will continue to work with them at future meetings.

Summary of Committee Recommendations

Human Capital Committee

1) Reevaluate the current approach to NASA Workforce recruitment in all disciplines
   Conclusion: Council Agreement with edits
2) Enhance NASA's efforts to attract highly qualified scientists and engineers for its space exploration programs
   Conclusion: Council Agreement with edits
3) Streamline procedures for hiring foreign nationals
   Conclusion: Council Agreement with edits
4) Consolidate education resources and programs
   Conclusion: Council Agreement with edits
5) Establish programs specifically targeted to the most academically talented K-16 math and science students
   Conclusion: Council Agreement with edits

Audit and Finance Committee

No formal recommendations

Observations:

1) stay the course; the corrective action plans are sound;
2) there is a lack of resources (such as direct reports to the Deputy CFO); don't have enough people to deal with the accounting problems facing NASA; though resources exist to hire, the OCFO is understaffed;
3) the Committee will look into the overall financial management of NASA programs.

Aeronautics Committee
No formal recommendations
Observation: Endorse process for research proposals. Involvement with stakeholders in the Aeronautics Program has a good start but is still under development.

Exploration Committee
No formal recommendations
Observation: The Exploration initiative at NASA is moving forward vigorously. There is a strong determination and will to succeed among NASA employees. The Exploration Committee will continue to monitor progress closely.

The Council agreed to add a recommendation that reflects the Ad Hoc Biomedical Committee report.

Science Committee
1) SMD should undertake a study of cost drivers (especially with regard to requirements creep) of large missions, especially with regard to process and procedures, to determine how much cost they contribute
2) SMD should assess the stability of the program in terms of an optimal portfolio of flagship, medium and small missions
3) SMD should define different levels of processes and procedures for small, medium and large mission classes
4) NASA's Astrobiology program should be treated in the same way as any other R&A program in future planning

Dr. Kennel indicated that he would craft a formal recommendation on the SSB report.

Closing Remarks
The next Council meeting is scheduled for July 19-20 at the Johnson Space Center in Houston, Texas. Committee Chairs should develop their agendas as soon as possible.

For other interested parties, the Council website is the best source of information.

Senator Schmitt adjourned the meeting at 3:45 p.m.

NASA Advisory Council Meeting
Pasadena, CA
May 18, 2006

Location
Von Karman Auditorium
Jet Propulsion Laboratory
4800 Oak Grove Drive
Pasadena, CA

Thursday, May 18th

8:00 a.m.	General Council Discussion	
8:30 a.m.	Human Capital Committee Report & Discussion	Dr. Gerald Kulcinski
9:45 a.m.	Audit and Finance Committee Report & Discussion	Mr. Robert Hanisee
11:00 a.m.	Break	
11:15 a.m.	Aeronautics Committee Report & Discussion	Mr. Neil Armstrong
12:30 a.m.	Lunch	
2:00 p.m.	Exploration Committee Report & Discussion	Lt. Gen. James Abrahamson
3:15 p.m.	Science Committee Report & Discussion	Dr. Charles Kennel
4:30 p.m.	Council Discussion and Agreement on Recommendations	
5:00 p.m.	Adjournment	

NASA Advisory Council Members

May 18, 2006

Chair	• Hon. Harrison H. Schmitt, Apollo 17 Astronaut and Scientist
Aeronautics Committee	• *Chair: Mr. Neil Armstrong, Apollo 11 Astronaut* • General Lester L. Lyles, USAF (Ret.), Consultant, The Lyles Group • Dr. Juan J. Alonso, Department of Aeronautics & Astronautics, Stanford University • Dr. Eugene Covert, T. Wilson Professor of Aeronautics, Emeritus, Department of Aeronautics and Astronautics, Massachusetts Institute of Technology
Audit and Finance Committee	• *Chair: Mr. Robert M. Hanisee, Trust Company of the West* • Hon. Edward R. "Ted" McPherson, Chief Executive, Intersolve Group, Inc. • Hon. Michael Montelongo, Senior Vice President, Strategic Marketing, Sodexho Inc. • Mr. Howard J. Stanislawski, Partner, Sidley Austin, LLP
Exploration Committee	• *Chair: Lt. Gen. James A. Abrahamson, USAF (Ret.)* • Dr. Wanda M. Austin, Senior Vice President, National Systems Group, The Aerospace Corporation • Capt. Frederick (Rick) Hauck, USN (Ret.)
Human Capital Committee	• *Chair: Dr. Gerald L. Kulcinski, Associate Dean of Research, College of Engineering, University of Wisconsin-Madison* • Ms. Joann DiGennaro, President, Center for Excellence in Education • Ms. Kay Coles James, Senior Partner, J.C. Watts Companies • Mr. Wendell Maddox, President and Chief Executive Officer, ION Corporation • Dr. R. James Milgram, Professor, Department of Mathematics, Stanford University
Science Committee	• *Chair: Dr. Charles F. Kennel, Director and Vice Chancellor of Marine Sciences, Scripps Institute of Oceanography* • Dr. Wesley T. Huntress, Jr., Director, Geophysical Laboratory, Carnegie Institution of Washington • Dr. Eugene H. Levy, Provost and Professor of Physics and Astronomy, Rice University • Dr. Mark S. Robinson, Research Associate Professor, Department of Geological Sciences, Northwestern University
Ex-Officio	• Dr. Raymond S. Colladay, Chair, Aeronautics and Space Engineering Board, National Research Council • Dr. Lennard A. Fisk, Chair, Space Studies Board, National Research Council • Dr. David Longnecker, Institute of Medicine, National Research Council
Unable to Attend	• Dr. Bradley L. Jolliff, Research Associate Professor, Department of Earth and Planetary Sciences, Washington University • Dr. John M. Logsdon, Director Space Policy Institute, George Washington University • Dr. Stephen I. Katz, M.D., Ph.D., Director, National Institute of Arthritis and Musculoskeletal and Skin Diseases • Dr. Neil DeGrasse Tyson, Frederick P. Rose Director, Hayden Planetarium, Department of Astrophysics, American Museum of Natural History

NASA ADVISORY COUNCIL
Jet Propulsion Laboratory
Pasadena, CA
May 18, 2006

MEETING ATTENDEES

Council Members:

Schmitt, Harrison, *Chair*	Astronaut and Scientist
Abrahamson, James	USAF (Ret.)
Alonso, Juan	Stanford University
Armstrong, Neil	Astronaut and Scientist
Austin, Wanda	The Aerospace Corporation
Blackerby, Christopher, *Executive Director*	NASA Headquarters
Colladay, Raymond, *Ex-Officio*	Aeronautics and Space Engineering Board
Covert, Eugene	Massachusetts Institute of Technology
DiGennaro, Joann	Center for Excellence in Education
Fisk, Lennard, *Ex-Officio*	Space Studies Board
Hauck, Frederick (Rick)	USN (Ret.)
Huntress, Wesley	Carnegie Institute of Washington
Kennel, Charles	Scripps Institute of Oceanography
Kulcinski, Gerald	University of Wisconsin-Madison
Levy, Eugene	Rice University
Longnecker, David, *Ex-Officio*	Institute of Medicine
Lyles, Lester	USAF (Ret.)
Maddox, Wendell	ION Corporation
McPherson, Edward	Intersolve Group, Inc.
Milgram, R. James	Stanford University
Montelongo, Michael	Sodexho, Inc.
Robinson, Mark	Northwestern University
Stanislawski, Howard	Sidley Austin

NASA Attendees

Abelson, Rob	NASA/JPL
Acosta, Andrea	NASA/JPL
Ahmed, Asif	NASA/JPL
Allen, Marc	NASA Headquarters
Angelopoulos, Vassilis	NASA/JPL
Battistali, Albert	NASA/JPL
Bertgh, Bill	NASA/JPL
Blom, Ronald	NASA/JPL
Brandon, Erik	NASA/JPL
Buis, Alan	NASA/JPL
Burdick, Garry	NASA/JPL
Cardener, Richard	NASA/JPL
Chinn, Cyndy	NASA/JPL
Chui, Talso	NASA/JPL
Clampin, Mark	NASA/GSFC
Cleave, Mary	NASA Headquarters
Cook, B.	NASA/JPL
Cooke, Doug	NASA Headquarters

Cosani, John	NASA/JPL
Craig, Jason	NASA/JPL
Davis, Gregory	NASA/JPL
Davis, John	NASA/JPL
Diaz, Angela Phillips	NASA Headquarters
Diginman, Paul	NASA/JPL
Dondrick, Scott	NASA/JPL
Donnellon, Andrea	NASA/JPL
Duncan, Courtney	NASA/JPL
Dunwoody, Cathy	NASA Headquarters
Eisenhardt, Peter	NASA/JPL
Evans, Jordan	NASA/JPL
Fliege, Charlayne	NASA/JPL
Flores, Richard	NASA/JPL
Fonz, Manfai	NASA Headquarters
Friedl, Randall	NASA/JPL
Gehrlein, Mike	Air Force
Gershman, Bob	NASA/JPL
Gerstenmaier, W.	NASA Headquarters
Gist, Emily	NASA/JPL
Glink, Peter	NASA/JPL
Green, Thomas	NASA Headquarters
Gross, M. A..	NASA/JPL
Gunson, Mike	NASA/JPL
Gutt, Gary	NASA/JPL
Herman, Martin	NASA/JPL
Hertz, Paul	NASA Headquarters
Howard, John	NASA/JPL
Howard, Rick	NASA Headquarters
Ilott, Peter	NASA/JPL
Ivanov, Mark	NASA/JPL
James, G.	NASA/JPL
Jankowski, Stan	NASA/JPL
Johnson, Torrence	NASA/JPL
King, Marla	NASA Headquarters
Kornfeld, Richard	NASA/JPL
Lahmidi, Wendy	NASA/JPL
Latham, Barron	NASA/JPL
Leshin, Laurie	NASA/GSFC
Lewis, Paulett	NASA/JPL
Lindstrom, David	NASA Headquarters
Lindstrom, Kurt	NASA Headquarters
Lomax, Terri	NASA Headquarters
Mays, C.	NASA Headquarters
McCleese, Dan	NASA/JPL
McCleese, Sean	NASA/JPL
McCowen, Jeff	NASA/JPL
Mendeck, Garin	NASA/JPL
Mispagel, Wendy	NASA/JPL
Moore, William	NASA/JPL
Moran, Kelly	NASA/JPL
Naderi, Firouz	NASA/JPL
Nelson, Robert	NASA/JPL
O'Toole, Rich	NASA/JPL
Ostrach, Louis	NASA Headquarters
Parham, Jane	NASA Headquarters

Pellis, Neal	NASA/JSC
Penanen, Roustantin	NASA/JPL
Plout, Jeffrey	NASA/JPL
Prikosouts, Jim	NASA/JPL
Rangoza, Maria	NASA/JPL
Rothschild, Lynn	NASA/ARC
Ryschkewitsch, Mike	NASA/GSFC
Sanders, Mike	NASA/JPL
Scrivner, Susan	NASA/JPL
Seers, Bernie	NASA/GSFC
Shannon, Maryann	NASA/JPL
Sheckler, Brant	NASA/JPL
Sherwood, K.	NASA/JPL
Sneddon, Scott	NASA/JPL
Staehle, Robert	NASA/JPL
Stetson, M.	NASA/JPL
Sullivan, Pam	NASA/GSFC
Thompson, N.	NASA Headquarters
Timmins, Craig	NASA/JPL
Tissot, Violet	NASA/JPL
Touchen, Henry	NASA/JPL
Trinh, Gene	NASA Headquarters
Vanacore, Andres	NASA/JPL
Villarreal, Lauren	NASA/JPL
Werries, Maria	NASA Headquarters
Wessler, Randi	NASA/JPL
Williams, Charlene	NASA Headquarters
Williams, Greg	NASA Headquarters
Williams, Powtawche	NASA/JPL
Winterhalter, Daniel	NASA/JPL
Wright, Malcolm	NASA/JPL
Wysocki, Cheryl	NASA/JPL
Yamarone, Charles	NASA/JPL
Young, Joseph	NASA/JPL
Zakrol, Dolores	NASA/JPL
Zlotnieki, Victor	NASA/JPL
Zuffada, Anzia	NASA/JPL

Other Attendees

Acaba, Ralph	[self]
Aldrin, Buzz	Starcraft Enterprise
Brooks, John	KFWB
Frankel, Paula	Consultant
Fredell, Robert	US Air Force
Friedman, Louis	The Planetary Society
Garnett, Montgomery	[self]
Hant, Matt	Aerospace
Johnson, Ronnie	Boeing
Kauffman, Wayne	General Dynamics
Margon, Bruce	STScI
Moses, Stewart	Northrop Grumman
Mousessian, Ardvas	Raytheon
Murrow, Dave	Ball Aerospace
Parsons, Kevin	Northrop Grumman

Pierson, Tom	SETI Institute
Purdy, William, Jr.	Ball Aerospace
Roberts, Mel	General Dynamics
Rosen, Stan	Toffler Associates
Sherman, Barbara	Boeing
Sykes, Mark	PSI
Wehrle, Ann	Space Science Institute
Wright, Edward	UCLA

NASA ADVISORY COUNCIL
Jet Propulsion Laboratory
Pasadena, CA
May 18, 2006

LIST OF PRESENTATION MATERIAL[1]
(In order it was presented at the meeting)

1) Human Capital Committee Recommendations [Kulcinski]
2) Report of Audit & Finance Committee [Stanislawski]
3) Pre-Recommendation Draft from the Exploration Committee [Abrahamson]
4) Preliminary Recommendation from the Biomedical Subcommittee [Longnecker]
5) Science Committee Recommendations to NAC Plenary [Kennel]

Other material distributed at the meeting:

1) Common Recommendations from the NAC Science Subcommittee
2) Letter from H., Schmitt to M. Griffin, April 3, 2006, Council Recommendations
3) February 2006 Meeting Minutes

[1] Presentation and other material distributed at the meeting is on file at NASA Headquarters, OER/ACMD, 300 E Street SW, Washington, DC 20546.